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ROAD TRANSITIONS BETWEEN LAND, SNOW AND ICE

Techdata Sheet

ROAD TRANSITION PROBLEMS

Maintaining continuing traffic in all seasons is a major need for effective polar operations. Working tide cracks that occur where land abuts a floating ice sheet can hinder vehicular traffic. In addition, water from melting snow can run onto ice or snow roads, causing potholes and melt pools. The mud and dirt that is tracked by vehicles onto an ice or snow road absorb solar radiation, resulting in the formation of potholes and deep ruts.

Special problems are encountered in road transitions from sea ice to glacier or shelf ice that is at a higher elevation. A snow ramp is used to make the transition from higher to lower ice, and, if poorly constructed, this ramp will trap drifting snow. Also, snow trapped at the vertical face imposes a downward force on the annual ice, which may result in the downwarping of the ice and the formation of surface pools of seawater.

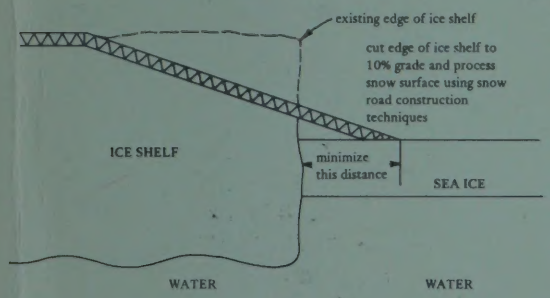

Figure 1. Sketch of sea-ice-to-shelf-ice transition.

Through investigation and field work, CEL has developed the following set of procedures for coping with road transition problems from sea ice to shelf ice, snow to land, and sea ice to land.

SEA-ICE-TO-SHELF-ICE TRANSITION

The snow ramp at the transition from sea ice to ice shelves should be constructed at a site where downwarping has not occurred. It should be cut into the ice shelf as far as possible to minimize surface loading of the sea ice. Snowdrift accumulation is reduced by constructing a snow ramp at least 75 feet wide and by rounding the shoulders of the cut in the ice shelf. For wheeled vehicles to maintain traction on the snow ramp under all weather conditions the grade of the ramp should not exceed 10% (see Figure 1).

Figure 2. CEL-fabricated flexible timber ramp.

SNOW-TO-LAND TRANSITION

The snow-to-land transitions may require 75 to 100 feet of surfacing material to reduce the amount of dirt tracked onto the snow road. A flexible, timber surfacing system is better suited for this transition than prefabricated surfacing materials, because it has openings to collect dirt. Also, this system costs about 60% less than prefabricated surfacing materials, and it can be removed and stored during nonuse periods.

The flexible timber ramp designed and tested by

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CEL consists of 6 x 6-inch wood beams that run perpendicular to the road, are separated by wood spacers, and are tied together by wire rope in sections 30 feet long (see Figure 2). More than one section can be tied together to form a longer ramp if needed.

SEA-ICE-TO-LAND TRANSITION

Field tests and observations indicate that a minimum of 75 feet of timber ramps (for dirt control) and 500 feet of surfacing material may be required at sea-ice-to-land transitions. The first timber ramp should be placed over the tide crack at the shoreline, and the remainder of the ramp placed on the sea ice to bridge any other cracks or pools of water. Prefabricated surfacing materials, such as MO-MAT (fiberglass matting) or AM_2 aluminum planking are best suited for extending the ramp onto the sea ice. Both of these materials have good and bad features. AM_2 planking is durable, but develops ice-clogged joints, thereby making it difficult to assemble. The MO-MAT must be well-anchored to withstand vehicular traffic and wind loads. Since these surfacing materials are thin, vehicles can enter or leave the ramp at any point to avoid areas of ice surface deterioration. Insulation is required under both materials; 1/4-inch plywood works reasonably well, but does not entirely eliminate melting.

Deterioration of the sea ice can be reduced by keeping a clean snow cover on the sea ice adjacent to the surfacing material until that location is used as a vehicle approach. Channeling surface water runoff from the land away from the road will also reduce the size and severity of melt pools.

Dirt ramps 1-1/2 feet thick can also be used at the sea-ice-to-land transition to traverse areas of melt holes, although this can compound the problem by contaminating the ice surface more. Timber ramps or rigid panels are necessary to bridge the larger tide cracks, and timber ramps should still be used at the end of the dirt to prevent excessive contamination of the ice.

REFERENCE

Based on CEL Technical Note N-1317: Improved Transition Ramps for McMurdo Station, Antarctica, by Frank W. Brier. Port Hueneme, CA, Nov 1973.

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